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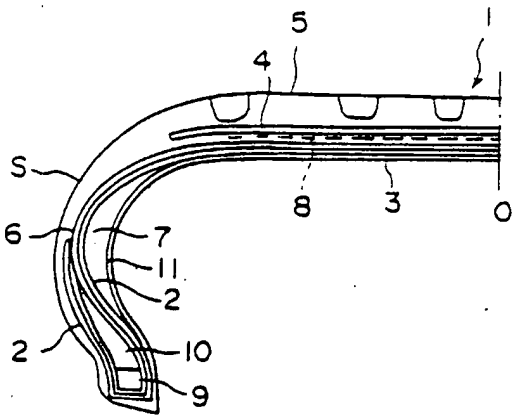
(54) PNEUMATIC RADIAL TYRE

(57) A radial pneumatic tire having excellent run-flat durability. The tire is equipped with a belt layer (4), which includes a plurality of metal cord layers, and a tread (5) successively at a periphery of a crown portion (3) of a toroidal radial carcass (2), and is equipped with, at an inner peripheral surface of the side portion (6) of the carcass, a rubber reinforcing layer (7) having a crescent moon shaped cross-section and bearing and supporting load. The tire has an auxiliary layer (8) disposed between the carcass and the belt layer and including organic fiber cords which are oriented so as to intersect the cords of the carcass and the cords of the belt layer with a central equatorial plane between, on the one hand, the cords of the auxiliary layer, and on the other hand, the cords of the carcass and the cords of the belt layer.

FIG. 1



EP 0 778 164 A1

Description

TECHNICAL FIELD

The present invention relates to a pneumatic radial tire, and more specifically, to a pneumatic radial tire which is strengthened by providing, at the sidewall of the tire, a rubber reinforcing layer having a crescent moon shaped cross-section, such that when the pneumatic tire installed on a vehicle is punctured during running, the tire can run for a considerable distance in the punctured state.

BACKGROUND ART

Conventionally, various measures have been devised for safely continuing running, without damaging the tire further and without disadvantages such as poor steering, over a distance from the place where the tire was punctured to a place desired by the driver, e.g., a service station where the tire can be changed, at the time when the internal pressure decreases or becomes zero (hereinafter, "punctured") for some reason, and in many cases, due to a foreign object such as a nail or a metal piece piercing the tire, during traveling of the pneumatic tire installed on a vehicle.

Among these measures, as a simple and effective measure for radial tires for passenger vehicles in particular, Japanese Patent Application Publication No. 52-41521 discloses art relating to a so-called side reinforced run-flat tire in which a rubber reinforcing layer having a crescent moon shaped cross-section is made to line the carcass inner peripheral surface of the sidewall which is the region in the tire having the lowest rigidity, so that the entire sidewall has approximately the same thickness and so as to provide rigidity.

In this side reinforced run-flat tire, in an ordinary state, the load is mainly supported by the internal pressure. When the tire is punctured, the supporting of the load is taken over by the rigidity inherent in the reinforced sidewall.

However, in this side reinforced run-flat tire, as illustrated in Fig. 2, when the tire is punctured, buckling of a sidewall S is avoided, but a crown portion 21 exhibits the phenomenon known as buckling, and a tread 22 is thereby lifted up from a road surface R. As a result, a portion 23 of the sidewall separated from the tread 22 contacts the ground.

In this ground-contacting state, obviously, stress concentrates and defects arise at an early stage at portions at which there is much bending deformation. As a result, in order to increase the durability of the run-flat tire, buckling of the crown portion 21 must be suppressed, and tire deformation must, as much as possible, be maintained the same as before the puncture.

Japanese Patent Application Laid-Open No. 6-191243 and Japanese Patent Application Laid-Open No. 6-191244 disclose techniques in which at least one organic fiber cord layer, which is effective for weight reduction, is disposed at the outer periphery of the belt layer, so as to increase the rigidity of the tread base portion.

However, these disclosed techniques do not exhibit sufficient effects for suppressing buckling, and the current situation is that, even if the rigidity of the tread base portion is increased even more by winding a plurality of layers, the effects are small in proportion to the increase in cost and in weight.

DISCLOSURE OF THE INVENTION

The present invention has taken into consideration the above-described problematic points, and an object thereof is to provide a pneumatic tire in which, when the tire is punctured, buckling of the crown portion is suppressed, and durability is increased.

The present invention is a pneumatic radial tire equipped with a belt layer, which includes a plurality of metal cord layers, and a tread successively on a crown portion periphery of a toroidal radial carcass, and equipped with, at a side portion inner peripheral surface of the carcass, a rubber reinforcing layer having a crescent moon shaped cross-section and bearing and supporting load, comprising: an auxiliary layer disposed between the carcass and the belt layer and including organic fiber cords which are oriented so as to intersect the cords of the carcass and the cords of the belt layer with a central equatorial plane between, on the one hand, the cords of the auxiliary layer, and on the other hand, the cords of the carcass and the cords of the belt layer.

As is known, a belt layer for improving the rigidity of the base portion of the tread is provided at the crown portion of a radial tire. The belt layer is usually formed by a plurality of steel cord layers. It is known that when, due to a puncture, the tread receives bending deformation so as to rise up, the steel cord layer becomes a neutral axis, and compressive force is applied to the tread and tension is applied to the carcass.

Accordingly, in a conventional reinforcing method in which the outer periphery of the belt layer is additionally reinforced, the compression side is reinforced, and the intrinsic tensile direction high elasticity of the reinforcing cord is not generated.

The present invention is equipped with an auxiliary layer at the side of the crown portion of the tire to which side tension is applied at the time of a puncture. Accordingly, even if the cords are reinforced by flexible organic fibers, the crown portion is effectively provided with flexural rigidity, and rising up of the tread at the time of a puncture can be effec-

tively suppressed. As a result, local concentration of stress can be avoided, and the run-flat running can be greatly improved. In this case, it is preferable that the cords of the auxiliary layer intersect the central equatorial plane at an angle of greater than or equal to 30°, because at angles of less than 30° with respect to the central equatorial plane, sufficient tire radial direction rigidity cannot be obtained and buckling cannot be suppressed. It is even more preferable that the cords of the auxiliary layer are in a range of 45 to 75° with respect to the central equatorial plane. It has been confirmed that, in order to sufficiently and effectively suppress buckling, there must be sufficient tire radial direction rigidity, and circumferential direction rigidity must be maintained, and the angle with respect to the equatorial plane is optimally in a range of 45 to 75°.

Other than aramide, polyester, rayon, and the like can be optimally used for the organic fiber cords. Further, the number of organic fiber cord layers is not limited to one, and plural layers may be superposed such that the cords thereof intersect each other.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a tire cross-sectional view of an embodiment to which the present invention is applied.

Fig. 2 is a cross-sectional contour view illustrating deformation at the time a tire is punctured in accordance with a conventional art.

PREFERABLE EMBODIMENT FOR IMPLEMENTING THE INVENTION

In order to confirm the effects of a tire to which the present invention was applied, run-flat durability due to actual running on a vehicle was evaluated for 205/65R15 size Example tires and Conventional Example tires.

As the test method, each test tire was assembled to a 15 × 5 1/2J rim. After internal pressure was filled so that the bead fit the rim, the valve core was removed, and the test tires having an internal pressure of substantially zero were respectively installed on the front right wheel of a passenger vehicle. The tires were run on a test track at a constant speed of 20 km/h. The driver sensed the generation of abnormal vibrations caused by a defect of the test tire (the limit of durability), and the running distance until the defect was generated was measured.

(Example 1)

Hereinafter, description will be given on the basis of the drawing. Fig. 1 is a cross-sectional view of a tire illustrating an embodiment of the present invention.

Fig. 1 is an example of a 205/65R15 size passenger vehicle tire. A carcass 2 is formed from two plies in which 1000d/2 polyester cords are disposed so as to be oriented substantially orthogonally to an equatorial plane O. Both end portions of the carcass 2 are wound up around bead rings 9 so as to form wound-up end portions 2'. A hard rubber bead filler 9 is embedded taperingly between the carcass 2 above the bead ring and the ply wound-up end portion 2' thereof.

At a side portion 5 inner peripheral surface of the carcass 2, a rubber reinforcing layer 6 (shore A hardness 84°, maximum width 10 mm) having a crescent moon shaped cross-section is disposed such that the entire sidewall S has a substantially uniform thickness from the position where the rubber reinforcing layer 6 is superposed on the bead filler via the carcass. Reference numeral 11 is an air-impermeable inner liner.

A belt layer 4 comprises two layers, each layer being a twisted structure in which 1 × 5 steel cords are disposed so as to be inclined at an angle of 26° with respect to the equatorial plane O, and the two layers are superposed such that the cords intersect one another. An auxiliary layer 8 which is more narrow than the belt layer is disposed between the belt layer 4 and the carcass 2.

In Example 1, the auxiliary layer 8 is disposed between the carcass 2 and the belt layer 4 and comprises organic fiber cords which are oriented so as to intersect the cords of the carcass and the cords of the belt layer with the central equatorial plane O between, on the one hand, the cords of the auxiliary layer, and on the other hand, the cords of the carcass and the cords of the belt layer. The auxiliary layer 8 is formed by one rubber-coated layer in which 1670d/2 aramide cords are disposed at an angle of 20° with respect to the equatorial plane O.

The belt layer may be a structure strengthened by a cap layer which is formed by lining up a plurality of heat shrinking cords such as nylon or the like and winding the cords spirally in the peripheral direction of a rubber coated strip, at the entire periphery or a predetermined region of the belt layer.

Although the details of the half at the right side of the equatorial plane O are omitted from Fig. 1, there is symmetry to the left and the right.

(Example 2)

In Example 2, the reinforcing layer 8 of Example 1 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 30° with respect to the equatorial plane O. Example 2 is substantially similar to Example 1

in all other respects.

(Example 3)

In Example 3, the reinforcing layer 8 of Example 1 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 45° with respect to the equatorial plane O. Example 3 is substantially similar to Example 1 in all other respects.

(Example 4)

In Example 4, the reinforcing layer 8 of Example 1 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 60° with respect to the equatorial plane O. Example 4 is substantially similar to Example 1 in all other respects.

(Example 5)

In Example 5, the reinforcing layer 8 of Example 1 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 75° with respect to the equatorial plane O. Example 5 is substantially similar to Example 1 in all other respects.

(Example 6)

In Example 2, the reinforcing layer 8 of Example 1 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 90° with respect to the equatorial plane O. Example 2 is substantially similar to Example 1 in all other respects.

(Comparative Example 1)

In Comparative Example 1, one layer of the same structure as the auxiliary layer 8 is disposed between the belt layer and the tread. The reinforcing layer 8 is formed from one rubber-coated layer in which aramide cords are disposed at an angle of 60° with respect to the equatorial plane O. Comparative Example 1 is substantially similar to Example 1 in all other respects.

(Comparative Example 2)

Comparative Example 2 is substantially similar to Example 1 except that no additional cord layer such as the auxiliary layer 8 is used.

The results of measurement of the running distances until defects occurred are listed in the following table.

		Examples						Comparative Examples	
		1	2	3	4	5	6	1	2
Organic Fiber Reinforcing Layer 8	Exists?	Yes						Yes	No
	Placed	Between carcass and belt						Between belt and tread	-
	Number of Layers	1 layer						1 layer	-
	Angle	20°	30°	45°	60°	75°	90°	60°	-
Running Distance until Defect (km)		5	7	10	15	12	9	3	2

In this way, run-flat durability can be advantageously improved by placing between the carcass and the belt layer an auxiliary layer including organic fiber cords which are oriented so as to intersect the cords of the carcass and the cords of the belt layer with the central equatorial plane between, on the one hand, the cords of the auxiliary layer, and on the other hand, the cords of the carcass and the cords of the belt layer, as compared with a tire having, at the side

portion inner peripheral surface of the radial carcass, a rubber reinforcing layer which has a crescent moon shaped cross-section and bears and supports the load.

PRACTICAL USE OF THE INVENTION IN THE INDUSTRY

As described above, the pneumatic radial tire relating to the present invention is useful for use as a tire for a vehicle, and in particular, the pneumatic radial tire which can run for a long distance even if punctured is extremely useful to the automotive industry in today's vehicle-oriented society.

Claims

1. A pneumatic radial tire equipped with a belt layer, which includes a plurality of metal cord layers, and a tread successively on a crown portion periphery of a toroidal radial carcass, and equipped with, at a side portion inner peripheral surface of the carcass, a rubber reinforcing layer having a crescent moon shaped cross-section and bearing and supporting load, comprising:

   an auxiliary layer disposed between the carcass and the belt layer and including organic fiber cords which are oriented so as to intersect the cords of the carcass and the cords of the belt layer with a central equatorial plane between, on the one hand, the cords of the auxiliary layer, and on the other hand, the cords of the carcass and the cords of the belt layer.

2. A pneumatic radial tire according to claim 1, wherein the cords of said auxiliary layer intersect the central equatorial plane at an angle of greater than or equal to 30°.

FIG. 1

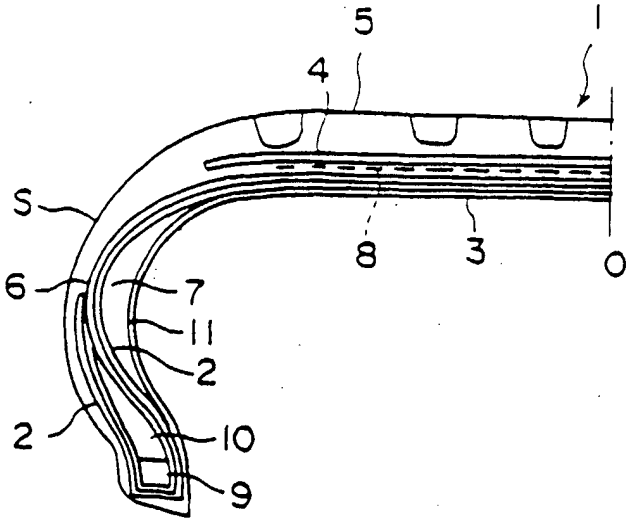
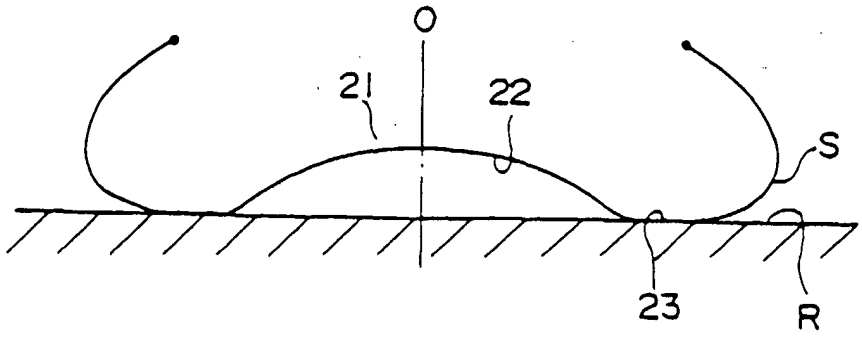


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/01568

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 B60C17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 B60C17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926 - 1996
Kokai Jitsuyo Shinan Koho 1971 - 1996

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 2-147417, A (Sumitomo Rubber Industries, Ltd.), June 6, 1990 (06. 06. 90), Page 4, upper left column, line 15 to lower left column, line 5 & EP, 371755, A2 & AU, 4567089, A1 & US, 5058646, A & DE, 68912097, T2	1 - 2
X	JP, 2-283508, A (Pirelli Korldinament Puneumatichi S.p.A.), November 21, 1990 (21. 11. 90), Page 4, lower right column, lines 10 to 20 & IT, 19615, A	1 - 2

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
September 3, 1996 (03. 09. 96)	September 17, 1996 (17. 09. 96)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)